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TREATMENT OF STAMMERING THROUGH THE USE OF A NEW ELECTRONIC DEVICE.

BY- WEPMAN, JOSEPH M. MCFARLAND, ROBERT L.
CHICAGO UNIV., ILL., SPEECH AND LANG. RES. LAB.

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TO DETERMINE WHETHER A SMALL PORTABLE INSTRUMENT COULD BE USED WITH SPEECH THERAPY TO REDUCE STAMMERING SEVERITY, AN ELECTRONIC SOUNDMAKING DEVICE WAS DEVELOPED. INDIVIDUALLY FITTED WITH MOLDED EARPLUGS, THE DEVICE WAS SIMILAR TO A HEARING AID BUT PRODUCED A CONSTANT TONE OF SUFFICIENT VOLUME TO INTERRUPT AUDITORY FEEDBACK DURING SPEECH AND THEREBY TO REDUCE THE CIRCULARITY OF NONFLUENCY. TO TEST THE DEVICE, SUBJECTS WERE SELECTED FROM GRADE SCHOOL, HIGH SCHOOL, AND COLLEGE. HALF OF THE SUBJECTS RECEIVED BIWEEKLY 1-HOUR SPEECH THERAPY FOR 6 MONTHS WITH THE USE OF THE AID. THE REMAINING SERVED AS CONTROLS AND RECEIVED NO THERAPY. EACH OF THE 24 SUBJECTS WAS PRE- AND POSTTESTED WITH (1) FOUR SUBSCALES OF THE WECHSLER ADULT INTELLIGENCE SCALE OR THE SAME SUBSCALES OF THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN, WHICHEVER WERE AGE APPROPRIATE, (2) THE IOWA SCALE OF SEVERITY, AND (3) THE GRAY ORAL READING TEST (EVALUATED IN TERMS OF TIME IN SECONDS TAKEN TO READ THE ASSIGNED PARAGRAPHS). PRETESTS INDICATED NO STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN THE TWO GROUPS ON AGE, INTELLIGENCE, OR THE GRAY TEST AND IOWA SCALE. ALSO, POSTTESTS INDICATED THAT THE GRAY TEST WAS NOT SIGNIFICANT BETWEEN THE TWO GROUPS IN PRE- AND POSTTRAINING ASSESSMENT. THE RATINGS ON THE IOWA SCALE, HOWEVER, INDICATED SIGNIFICANT IMPROVEMENT IN THE EXPERIMENTAL GROUP (BEYOND THE .05 LEVEL) AS COMPARED TO THE CONTROL GROUP. IN ADDITION, THE THERAPIST JUDGED 10 OF THE EXPERIMENTAL SUBJECTS AS IMPROVED, AND THE SUBJECTS THEMSELVES CONSIDERED THE DEVICE HELPFUL. FURTHER RESEARCH IS URGED, AND A SCHEMATIC DRAWING OF THE AID IS INCLUDED. A TABLE PRESENTS DATA, AND A BIBLIOGRAPHY LISTS 12 ITEMS. (GD)

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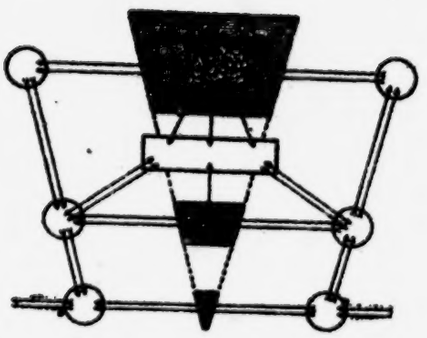
Joseph M. Wepman, Ph.D.
Robert L. McFarland, Ph.D.

The University of Chicago



SPEECH AND LANGUAGE RESEARCH LABORATORY
THE UNIVERSITY OF CHICAGO

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Joseph M. Wepman, Ph.D.

Robert L. McFarland, Ph.D.

The University of Chicago
5801 South Ellis Avenue
Chicago, Illinois 60637

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INTRODUCTION

New remedial speech therapy techniques of proven merit find ready application in the many speech classes and clinics throughout the country. When such new approaches concern the impelling problem of stammering or non-fluency their importance is markedly enhanced. This symptom-complex, while broadly studied and extensively treated, has not as yet responded to either research or therapy in such a way as to gain complete acceptance as being due to one thing or another, or responding better to one therapeutic regime or another (3).

Over the years, however, a generally practiced speech therapy technique has developed which might almost be called standard since it is practiced with many variations by so many speech therapists. It can be epitomized best as being a psychologically oriented reorganization of the speech act. One of its major problems lies in the difficulty produced by non-fluency itself, i.e., an instance of blocking in speech enhances the likelihood of blocking, or, stated otherwise, non-fluency creates non-fluency. The present exploratory research attacks this aspect of therapy directly. It investigates the effectiveness of a new electronic, sound-making device which is used to interrupt a speaker's auditory feedback and thereby reduce the circularity of non-fluency.

Cherry and Sayers (2) demonstrated in 1954 that low frequency tones introduced bilaterally into the auditory meatus of a stammerer tended to reduce the frequency of stammering. Building on this principle Parker and Christopherson (7) constructed a device which was portable and could be worn by a subject much as a hearing aid is worn. The device

produced a constant tone of sufficient volume to effectively interrupt the auditory feedback during speech. Trying the device on three severe stammerers they found a substantial reduction of non-fluency occurrences in spontaneous speech. While two of their three subjects had had speech therapy, the other had not. All three were adults whose non-fluency had become chronic and severely debilitating. No further reports of their efforts have as yet been published.

In preparation for the present research the co-investigator (Robert McFarland), using a prototype device modeled after the Parker and Christopherson instrument, coupled a dyadic speech therapy program with a strong psychological orientation with seven stammerers.

Clinically it appeared that five of the seven were substantially benefited by the combined approach. Since more benefit was derived from the combined method, success was estimated, then, by the therapist's efforts in previous stammering therapy without the use of interrupted auditory feedback (5).

OBJECTIVES

The present research was undertaken with a number of goals in mind: First, to determine whether a more portable, smaller instrument could be developed, one which could be worn inconspicuously in any situation without calling undue attention to itself; Second, to discover on a wide age range of stammerers, including children, whether the use of the device when associated with standard speech therapy for a reasonable period of time would reduce the stammering severity.

While only an exploratory design was contemplated at this time, it was foreseen that if both goals could be achieved, even in a suggestive

way, a method might well be introduced for attacking at least one of the problems of stammering therapy--the circularity of non-fluency producing more non-fluency. If speech therapy could then assist the stammerer more effectively, it would be worthwhile to broaden the investigation and to consider at some length some of the theoretical implications. At the outset, therefore, the present research was seen as an attempt to determine the basic efficacy of producing a workable instrument and to establish one use of the method, leaving theoretical considerations and other potential uses to future research and application.

RELATED RESEARCH

The literature on stammering is an extensive one, most of which, however, is irrelevant to the present study. Perhaps the closest to the study is the relatively new work on behavioral manipulation through operant conditioning. By the experimental conditioning techniques proposed, Chase (1) and Neeley (6), among others, have used delayed auditory feedback which serves to interrupt the stammerer's perception of his own non-fluency. Since, however, this is delayed speech, it serves to direct the speaker's attention to his speech efforts and tends to increase the non-fluency. Delayed auditory feedback seems to be diametrically opposed to the goals of the present research, although both methods attack the circularity of the stammering act.

Studies of therapy for stammering and discursive theoretical publications have failed to consider the effect of auditory cancellation in the manner here suggested and in consequence are found to have little bearing on the proposed research. Only the previously mentioned work

of Cherry and Sayers (2) and Parker and Christopherson (7) seem to have immediate relation to the study itself.

The question of feedback and its relation to cognition, while unrelated specifically to the study, also has been rather widely discussed recently. The work of the co-investigator and his colleagues in the development of concepts in the role of feedback mechanisms in cognition (8) (9) is widely known. It was interest in this aspect of the present research that led initially to the investigators' determination to explore the effect of interruption of external auditory feedback upon the expressive language of the stammerer and thereby the disruption of the normal sensory-motor choice of neural events.

The availability of a useful scale of stammering severity (Sherman), as reported, made the present study feasible, since judgements of change in stammering could be relied upon. While judges' opinions had previously been used as an assessment of stammering, this scale permitted a more objective and reliable assessment.

PROCEDURES

To accomplish the first goal or phase of the research, a modification of the electronic aid described and pictured by Parker and Christopherson (7) was constructed by Macan Engineering Company, Chicago, Illinois, under the supervision of the co-investigator. Among these modifications were 1) individually fitted, molded ear plugs as used in many hearing aids. This provided a more comfortable and useful fit for the subjects and assisted in machine efficiency reducing the volume needs. It also guaranteed an instrument that would not be easily dislodged by active

children. 2) The size of the noise generator was reduced by almost 50 percent, producing a more inconspicuous device as well as one of considerably lighter weight. 3) Non-interchangeable plugs were used for the remote control switch and the two earphones. This reduced the frequent wire breakage at the connection points, a matter of some concern in attempting to keep the devices in constant use during the research program.

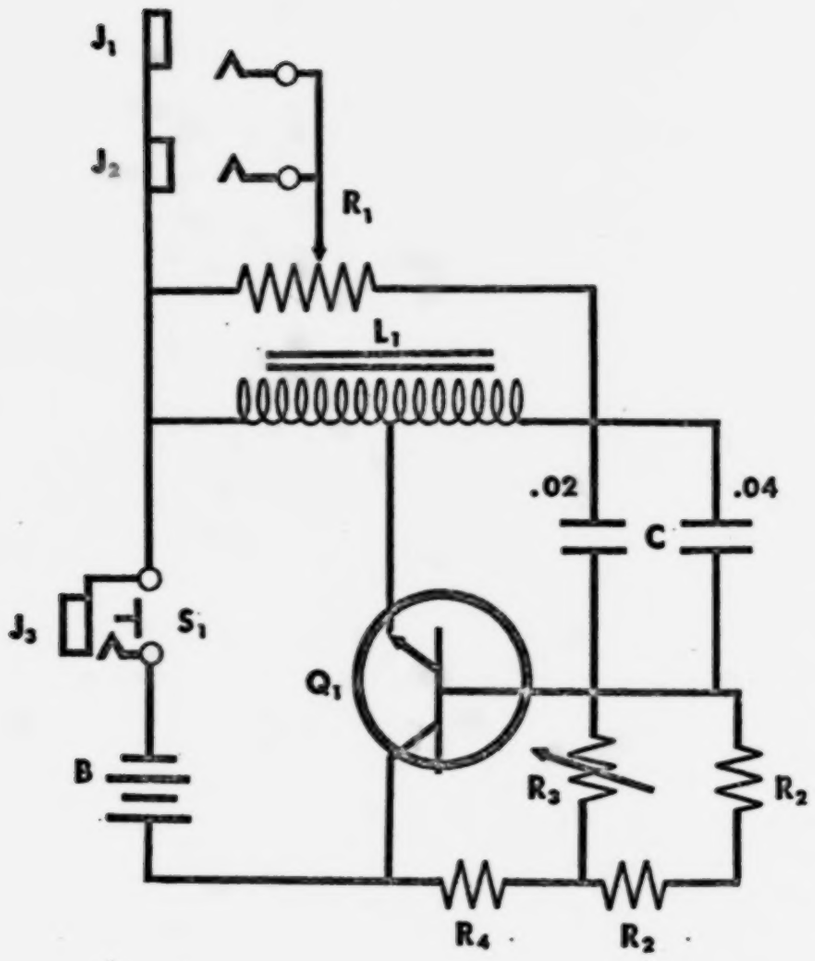
A schematic design of the newly adapted device appears as Figure 1.

Figure 1

The device (EAS or Electronic Aid for Stammerers) is basically a transistorized noise generator capable of being adjusted individually to the idiosyncratic pitch level of comfort for any user. It is fitted with two earphones and operated by the subject through a simple on/off remote switch. For purposes of interrupting auditory feedback, the earphones are placed in either ear. The plugs are made from individual molds of each subject. The device is activated just before a speaker begins to speak. It is off or deactivated at all other times. The earphones, like a hearing aid, are left in situ throughout the conversation. They do not affect the subject's hearing when not in use.

The test of the efficacy of the device during speech to determine its value as an adjunct to speech therapy was accomplished in the following manner.

Subjects were selected from two referral sources, the local parochial (Catholic) grade and high schools and the University of Chicago



PARTS

J_1, J_2, J_3	Switchcraft 42A jacks
Q_1	2N1102
S_1	Grayhill 35-1
L_1	3-30 mh. (set at 30) UTC TVC-9
R_1	20K 25 turn pot. Bourns Model 3068
R_3	500K " " " " " "
R_2	940K (2-470K in series)
R_4	47K
C	.06 mfd. (.02 & .04 in parallel)
B_1	9V Burgess 2N6

FIGURE 1

Schematic for Electronic Aid for Stammerers

Speech and Language Clinic. 24 such subjects were seen, 8 at each of three age/education levels, grade school, high school and college. The 24 subjects were divided into two groups; 4 in each age/education group (N = 12) were assigned to speech therapy with the use of the aid. They are identified hereafter as the Experimental (E) group. The remaining 12 were not assigned to therapy and received none during the six months of the study. They were identified as the Control (C) group. The assignments were made in the order of referral, thus obviating any researcher or therapist bias in selection. (It was recognized that a more adequate design would have included speech therapy without the aid for the Control group. Neither time nor economics permitted this design. To maintain a degree of control over the therapy situation it was felt to be necessary to use a single experienced therapist rather than different therapists which would have confounded any results achieved through the further comparison of therapist efficiency, commitment, et cetera. Since the single therapist could at best treat only 12 subjects in the six month period, the Experimental group was limited to that number.)

Each of the 24 subjects was interviewed by the co-investigator and pre-treatment psychological tests and speech and reading samples were collected by a trained psychologist.

The tests used were a short-form (four subscales) Wechsler Adult Intelligence Scale (WAIS), or the same subscales of the Wechsler Intelligence Scale for Children (WISC), whichever was age-appropriate. The four subscales used were (a) Comprehension, (b) Similarities, (c) Digit Symbol (Coding), and (d) Picture Arrangement.

The oral verbal samples were collected on tape by two methods. (a) The first sample included reading aloud age and grade appropriate selected portions of the Gray's Oral Reading Test. Grade school subjects read paragraphs 3, 4, and 5. High school subjects read paragraphs 7, 8, and 9. College subjects read paragraphs 11 and 12. (b) The second sample of an oral verbal corpus was obtained through an interview relating to four questions. This portion was also tape recorded. The questions asked to which the subjects were asked to respond orally in as elaborate a manner as possible were:

1. How does a violin, or some other musical instrument work?
2. For BOYS only: How does a bicycle work?

   For GIRLS only: How do you go about setting someone's hair?
3. How do people make speech? Do you know how someone's voice works?
4. What is it that makes you stutter? What is different about a person's talking when they do that?

These conversations were recorded with S's knowledge. Each subject was encouraged to be as elaborate, detailed and complete as possible. The Ss did not question the relevance of these tasks and collectively appeared challenged to complete them.

Upon the completion of pre-training testing each subject of the E group was re-interviewed by the co-investigator. At this time he was fitted with his personal ear-molds and instructed in the use of the device. He was then referred to the speech therapist.

For six months each of 11 subjects were seen in biweekly, one hour speech therapy. (1 E subject dropped out near the end of the study due to illness.) They were initially instructed to use the device only during therapy, then at home as well, and finally in every speech situation.

The speech therapist kept copious progress notes of each subject's progress during the course of the therapeutic regime. At the conclusion of the six-month period for each subject, the therapist made a rating of change in non-fluency as she saw it on a four point rating scale (no improvement, some improvement, improvement, and significant improvement). These ratings were sealed and kept from inspection by other members of the research team.

At the conclusion of the six-month period, all available subjects, Experimental and Control (N's = 11 and 5, respectively, 1 E subject having withdrawn because of illness and 4 of the Controls having rejected further contact with the study) were retested with the same battery of psychological test and verbal sample collection indicated earlier in the pre-treatment period.

RESULTS, CONCLUSIONS AND IMPLICATIONS

The comparability of the two groups was assessed by using the Wald - Wolfowitz runs test as discussed in Siegel (10). No statistically significant differences were found between Age, Intelligence, or on two independent measures of stammering severity. The latter consisted of ratings of severity of stammering based on judgements made by independent judges using the Iowa Scale for measuring the severity of stuttering (4) as a basis for the judgements. The second estimate of severity was established as a temporal measure of time taken to read aloud the Gray Oral Reading Paragraphs.

The decrease in Iowa Scale value and the decrease in time were seen as indicators of positive change. Increases in either parameter were considered as negative change.

In addition to the foregoing, the speech therapist rated each stammerer upon the conclusion of the six months of therapy. Table 1 shows her estimate of change.

Table 1

These results were interpreted as indicating that in the therapist's opinion the use of the aid was beneficial in 10 of the 11 subjects with a preponderance of Ss showing a general or significant degree of improvement in the six-month period.

The independent judgement of change was based upon the pre- and post-training assessment of verbal behavior on the reading and interview material.

The timing test (time in seconds to read the assigned paragraphs) proved to be not significant between the two groups in the pre- versus post-assessment. Thus, the temporal measure of success in fluency as indicated by the elapsed time necessary to read a given passage aloud seems unaffected by standard speech therapy with the use of the electronic aid when compared with a group who engaged in no speech therapy during the same calendar period. While no test of speech therapy without the aid was attempted, as explained previously, the aid appears to add nothing to the ability to read more rapidly when the device is used in conjunction with speech therapy.

The ratings of severity of stammering based on the Iowa Scale, however, showed quite different results. Here, of the Experimental group, 6 subjects were judged as improved, 3 as unchanged and 2 as

Table 1

SPEECH THERAPIST RATINGS OF IMPROVEMENTS

N = 11

Showed no improvement	1
Showed some improvement	2
Showed improvement	3
Showed significant improvement	5
	11

worse, while in the Control group (N = 6), 2 were judged as better, 2 as unchanged and 4 as worse.

These judgements were subjected to Tocher's modification of Fisher's Exact Probability Test (10). Using this non-parametric method the differences between the groups were seen to be significant beyond the 5 percent level.

On two of the assessments of verbal behavior, the therapist's ratings and the judgement of non-fluency, there appears to be reason to consider the exploration of the device as indicating a good facilitory effect upon the complex problem of stammering.

While it is not suggested that this study reveals anything but an implied benefit (the research design, the time allotment, the variety of data collection problems, et cetera), there is reason to believe from the results obtained that the device has beneficial effects when used in conjunction with therapy. This has been sufficiently attested to by the interest the subjects showed in continuing through the study and in their own concepts of the change effected.

While not considered as a working parameter of evaluation in this study, the subject's opinion was sought following the study and, in general, they believed the device had been beneficial. The speech therapist who had no personal involvement other than the natural one of desiring whatever benefits could be derived in therapy by using the aid also held the opinion that the aid was beneficial.

In many ways the investigators believe that these subjective findings may be of more import than the statistical formulations reported. If both subjects and therapist believe the aid to be of an enhancing value it would be worthwhile to explore its efficacy further in more elaborate studies with more elaborate research designs.

The 12 instruments designed, built and used in the study demonstrate its present mechanical and structural efficiency. The device is now of a size and at a sufficient level of efficiency to make it a feasible instrument for clinical use in a variety of situations.

These particular instruments will be used in the Speech and Language Clinic on other populations. If continued success is obtained in their use, attempts will be made to attack the problem of their efficacy in other research endeavors.

The investigators will report in a later paper the implications from the study in a general feedback-system theory context.

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PROFESSIONAL PERSONNEL INVOLVED IN THE STUDY

Joseph M. Wepman, Ph.D., Professor of Psychology and Surgery, The University of Chicago.

Robert L. McFarland, Ph.D., Associate Professor of Psychology, Northeastern Illinois State College.

Richard J. Robertson, Ph.D., Research Director, Restoration Center, Veterans Administration Hospital, Hines, Illinois.

Nancy Ham, M.A., Speech Therapist, Instructor, Central YMCA College.